Journal of Advances in Medicine and Medical Research

31(11): 1-4, 2019; Article no.JAMMR.53639
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

The Imaging Features of Isocitrate Dehydrogenase Mutant Gliomas

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JAMMR/2019/v31i1130334
Editor(s):
(1) Dr. Muhammad Torequl Islam, Assistant Professor, Department of Pharmacy, Faculty of Life Science, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Bangladesh and Researcher, Ton Duc Thang University, Vietnam.
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Complete Peer review History: http://www.sdiarticle4.com/review-history/53639

Review Article

Received 05 November 2019
Accepted 10 January 2020
Published 23 January 2020

ABSTRACT

To appraise Magnetic resonance imaging features of isocitrate dehydrogenase (IDH) mutant gliomas. In literature, IDH mutant gliomas are usually in frontal lobes, they are less contrast-enhancing with well-defined borders. They have high ADC values low regional cerebral blood volumes. 2-HG detection of MR spectroscopy has more promising results.
In this review, we tried to describe conventional and advanced neuroimaging features of IDH mutant Gliomas.

Keywords: Glioma; IDH; mutant; MRI; MR spectroscopy; MR perfusion.

1. INTRODUCTION AND LITERATURE EVIDENCE

The revised World Health Organization (WHO) 2016 classification [1] subdivides grades II, III and IV Diffuse gliomas into isocitrate dehydrogenase (IDH) mutant and IDH wild-type glioma. WHO grade II and III gliomas, as well as in secondary glioblastoma usually show mutations [2]. Recent studies revealed that IDH mutant gliomas show favourable positive effects on survival and chemosensitivity [3,4]. The Gold standard for detecting mutations are the immunohistochemistry and genomic sequence analysis. The disadvantage is, these methods are invasive and sometimes biopsy leads to erroneous results due to tumour heterogeneity. The lesion heterogeneity sometimes reduces the

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yield of biopsy and genomic analysis. This heterogeneity provides opportunities for medical imaging procedures that can assess the entire lesion in a noninvasive and reproducible way. This is the reason, a non-invasive and accurate method such as MRI with variable imaging protocols is highly valuable to predict IDH mutation. Different MRI sequences have great potential in routine clinical practice and these could be of great help with the implementation of appropriate procedures in patients with diffuse gliomas [5].

Magnetic resonance imaging (MRI) has proved a vital non-invasive modality of choice for examining gliomas. Recently, multiple studies reported on the imaging features and the great analytic performance of MRI for extrapolation of IDH mutation in patients with glioma [6-16].

The various MRI modalities have been used, including conventional MRI as well as advanced techniques such as diffusion-weighted imaging (DWI) or perfusion-weighted imaging (PWI). Also, detection of oncometabolite 2-hydroxyglutarate on MRS has been introduced images of sensitive for detection of IDH mutation [17]. Currently, the radionics approaches using quantitative imaging features have been successfully used in detecting IDH mutation [18]. Therefore, the purpose of our review is to restate the imaging features of IDH mutant glioma and highlight the analytic performance of MRI for prediction of IDH mutation in patients with diffuse gliomas.

2. LITERATURE EVIDENCE

There are several studies which used conventionally as well as advanced features to predict IDH mutation.

As shown in Table 1, the features of frontal lobe location [14,19,20,21,22,23], less contrast [14,20,24,25,26] with well defined borders [27,28] are more predictive of mutation. Other features such as T2 FLAIR mismatch [29] and Other features such as T2 FLAIR mismatch and high ADC values are also in favour of IDH mutation [30,31].

To simplify it, these authors state that IDH mutant lesions are usually in the frontal lobes as compared to the non-mutant ones. The mutant lesions are less vascular with well-defined borders.

Also, Advanced imaging such as DTI, perfusion and spectroscopy provide a clue in a reliable fashion. The IDH mutant glioma does not show a destructive pattern on diffusion tensor imaging (DTI) and fractional anisotropy(FA) value is significantly lower in mutant glioma than wild-type gliomas [30,31,28]. On PWI, several studies consistently proved that IDH mutant glioma showed lower relative cerebral blood volume (rCBV) values and lower tumour blood flow (rCBF) than IDH wild-type gliomas [31,28].

Table 1. Conventional MR features

MR features/Main Findings	Studies by
Frontal lobe location	Nakae S, Murayama K, Sasaki H, et al., Lasocki A, Tsui A, Gaillard, et al, Delfanti RL, Piccioni DE, Handwerker J, et, Wasserman JK, Nicholas G, Yaworski R, et al., Sonoda Y, Shibahara I, Kawaguchi T, et al., Reyes-Botero G, Dehais C, Idbaih A, et al, Carrillo JA, Lai A, Nghiemphu PL, et al.
Less contrast enhancement	Nakae S, Murayama K, Sasaki H, et al., Lasocki A, Tsui A, Gaillard, et al, Wang K, Wang Y, Fan X, et al, Choi C, Raisanen JM, Ganji SK, et al., de la Fuente MI, Young RJ, Rubel J, et al.
Well defined borders	Delfanti RL, Piccioni DE, Handwerker J, et al.
T2 FLAIR mismatch	Patel SH, Poisson LM, Brat DJ, et al.
High ADC values	Xing Z, Yang X, Leu K, Ott GA, Lai A, et al., 31, Wasserman JK, Nicholas G, Yaworski R, et al, Price SJ, Allinson K, Liu H, et al.

Table 2. Advanced MR features

MR features	Studies by
DTI minimally invasive	Tan W, Xiong, et al.
FA map low values	Lee S, Choi SH, Ryoo I, et al
Low relative cerebral blood flow	Xing Z, Yang X, 34, Leu K, Ott GA, Lai A, et al, de la Fuente MI, Young RJ, Rubel J, et al
2 hydroxyglutarate MRS	Xiong J, Tan W, Wen J, et al

The quantitative evaluation using 2-hydroxyglutarate MRS [19] requires dedicated software and is also a reliable method for IDH mutation.

3. CONCLUSION

IDH mutant gliomas show less aggressive behaviour as compared to wild-type gliomas. MR has significant potential to non-invasively give the clue about mutation and 2-hydroxyglutartae MRS has significantly high-sensitivity than other sequences.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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